Association Between Body Mass Index And Cardiorespiratory Endurance Among Icse School Students

Mangeshkumar D. Mukhiya
P.E. Teacher, Caelum High School & Jr. College, Pune

ABSTRACT

Body Mass Index (BMI) and cardiorespiratory endurance are important indicators of health-related physical fitness among adolescents. The present study examined the association between BMI and cardiorespiratory endurance among 224 ICSE school students studying in Classes VIII to X. Height and body weight were measured to calculate BMI, while cardiorespiratory endurance was assessed using the 600-metre run/walk test. The study adopted a quantitative, non-experimental, cross-sectional correlational research design. Descriptive statistics and Pearson's product-moment correlation were used for data analysis. The mean BMI was 20.31 ± 3.98 kg/m² and the mean 600-metre completion time was 207.81 ± 70.40 seconds. A statistically significant positive association was found between BMI and 600-metre completion time, r(222) = 0.175, p = 0.009. The association was weak, indicating that higher BMI was related to slightly slower endurance performance, while other factors may also influence cardiorespiratory endurance. The findings highlight the importance of regular physical activity, healthy lifestyle practices, and periodic monitoring of health-related fitness among school-going adolescents.

Keywords : Body Mass Index, BMI, Cardiorespiratory Endurance, 600-Metre Run/Walk, Adolescents, Physical Fitness, ICSE Students

Introduction

Physical fitness is an important component of the overall health and development of children and adolescents. During adolescence, regular physical activity contributes to

healthy growth, development of physical abilities, psychological well-being, and the maintenance of healthy body composition. Health-related physical fitness includes cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, and body composition. Among these components, cardiorespiratory endurance is particularly important because it reflects the ability of the heart, lungs, and circulatory system to supply oxygen to the working muscles during prolonged physical activity. (Ortega et al., 2008; Lang et al., 2018)

Cardiorespiratory endurance is closely related to general health and physical performance. Adolescents with better cardiorespiratory fitness are generally better able to participate in sustained physical activities and may have lower risks of several health-related problems. Cardiorespiratory fitness has been identified as an important marker of health among young people and is associated with adiposity and cardiometabolic health outcomes. *(Ortega et al., 2008; Lang et al., 2018; Raghuveer et al., 2020)*

Body Mass Index (BMI) is one of the most commonly used anthropometric indicators for assessing the relationship between body weight and height. Although BMI does not directly measure body fat percentage, it is widely used in population-based studies and school health assessments to identify differences in body-weight status. Excess body mass may increase the physical demand of weight-bearing activities such as running and may negatively influence endurance performance. *(World Health Organization, 2006; Nuttall, 2015)*

Several studies have reported an association between body composition and cardiorespiratory fitness in children and adolescents. In general, higher body mass and excess adiposity may be associated with poorer endurance performance, although the strength of the relationship can vary according to age, sex, maturity, physical activity, and training status. *(Ortega et al., 2008; Lang et al., 2018; Raghuveer et al., 2020)*

Field-based running and walking tests are commonly used in school settings because they are practical, economical, and easy to administer to large groups of students. Such tests can provide meaningful information regarding cardiorespiratory fitness in children and adolescents. The 600-metre run/walk test is a practical field-based measure in which completion time provides an objective indicator of endurance performance; a shorter time indicates better performance. *(Ruiz et al., 2009; Tomkinson et al., 2018)*

Although previous research has examined the relationship between body composition and cardiorespiratory fitness, relatively fewer studies have focused specifically on ICSE

school students of Classes VIII to X using the 600-metre run/walk test. Therefore, the present study was conducted to examine the association between Body Mass Index and cardiorespiratory endurance, measured through 600-metre run/walk completion time, among ICSE school students studying in Classes VIII to X. *(Lang et al., 2018; Sember et al., 2022)*

Review Of Related Literature

Cardiorespiratory fitness is an important component of health-related physical fitness and reflects the ability of the cardiovascular and respiratory systems to supply oxygen to the working muscles during sustained physical activity. Research has consistently identified cardiorespiratory fitness as an important health marker in children and adolescents. *(Ortega et al., 2008; Raghuveer et al., 2020)*

Research has also examined the relationship between BMI, body composition, and aerobic fitness. Higher body mass may make weight-bearing activities such as running more physically demanding, potentially increasing energy expenditure and fatigue. Studies have generally reported an inverse relationship between BMI or adiposity and cardiorespiratory fitness, although the relationship may be influenced by several individual and environmental factors. *(Lang et al., 2018; Ortega et al., 2008)*

Physical activity and structured exercise can improve cardiorespiratory fitness among young people. School-based physical fitness assessment provides an opportunity to identify differences in fitness levels and to encourage appropriate physical activity and health promotion. *(Bull et al., 2020; Raghuveer et al., 2020)*

Field-based endurance tests are particularly useful in school settings because they require limited equipment and can be administered to large groups. Running and walking tests are therefore commonly used as practical indicators of cardiorespiratory fitness. The present study extends this area of research by examining BMI and 600-metre run/walk performance among ICSE students in Classes VIII to X. *(Ruiz et al., 2009; Tomkinson et al., 2018)*

Purpose Of The Study

The purpose of the present study was to examine the association between Body Mass Index and cardiorespiratory endurance among ICSE school students studying in Classes VIII to X.

Objectives Of The Study

1. To assess the Body Mass Index of ICSE school students studying in Classes VIII to X.
2. To assess cardiorespiratory endurance using the 600-metre run/walk test.
3. To examine the association between Body Mass Index and 600-metre run/walk completion time.
4. To determine whether the association between BMI and endurance performance is statistically significant.

Hypothesis Of The Study

It was hypothesised that there would be a statistically significant association between Body Mass Index and cardiorespiratory endurance, as measured by 600-metre run/walk completion time, among ICSE school students studying in Classes VIII to X.

Methodology

Research Approach

The present study adopted a quantitative research approach. Numerical data related to students' height, body weight, BMI, and 600-metre run/walk completion time were collected and statistically analysed.

Research Design

A quantitative, non-experimental, cross-sectional correlational research design was used. The design was non-experimental because no intervention or treatment was provided. It was cross-sectional because data were collected during a specific period of fitness assessment. The correlational component was used to examine the association between BMI and 600-metre run/walk completion time.

Participants and Sample

The participants consisted of 224 students studying in Classes VIII to X at Caelum High School & Jr. College, Pune. The participants were adolescents approximately between 13 and 16 years of age. Students with complete data for height, body weight, BMI, and 600-metre run/walk performance were included in the analysis.

Sampling Technique

Convenience sampling was used. Students who were available during the data collection period and completed the required fitness assessments were included in the study.

Variables of the Study

- Independent Variable: Body Mass Index (BMI)
- Dependent Variable: Cardiorespiratory endurance, measured through 600-metre run/walk completion time in seconds.

Tools And Equipment

The following tools and equipment were used for data collection:

- Stadiometer – for measuring height.
- Weighing machine – for measuring body weight.
- Measured running track or measuring tape – for marking the 600-metre distance.
- Stopwatch – for recording completion time.
- Data recording sheet and Microsoft Excel – for recording and organizing data.

Measurement And Testing Procedure

Height was measured in metres using a stadiometer with students standing upright and without footwear. Body weight was measured in kilograms using a weighing machine. BMI was calculated using the following formula:

BMI = Body Weight (kg) ÷ Height² (m^2)

Cardiorespiratory endurance was assessed using the 600-metre run/walk test. A measured 600-metre distance was marked, and students were instructed to complete the distance as quickly as possible according to their individual ability. Students were permitted to run or walk. Completion time was recorded in seconds using a stopwatch. Lower completion time indicated better endurance performance.

Data Collection Procedure

The following procedure was followed during data collection:

1. Permission was obtained from the concerned school authorities.
2. The purpose and procedure of the assessment were explained to the students.

3. Height and body weight were measured and recorded.
4. BMI was calculated using the standard formula.
5. The 600-metre distance was measured and marked.
6. Students performed the 600-metre run/walk test under supervision.
7. Completion time was recorded in seconds.
8. The data were organized and analysed using appropriate statistical procedures.

Ethical Considerations

The study was conducted with due consideration for the safety and well-being of the participants. The purpose and procedure were explained to the students, the fitness test was conducted under proper supervision, students were instructed to report discomfort, and individual identities were kept confidential. Individual names were not reported in the research findings.

Statistical Analysis

Descriptive statistics, including mean, standard deviation, minimum, and maximum values, were used to summarize the study variables. Pearson's product-moment correlation coefficient (r) was used to examine the association between BMI and 600-metre run/walk completion time. The level of statistical significance was set at $p < 0.05$.

Results

The present study examined the association between Body Mass Index and cardiorespiratory endurance among 224 ICSE school students studying in Classes VIII to X. BMI was calculated from height and body-weight measurements, while endurance was assessed through the 600-metre run/walk test.

Descriptive Statistics

Table No.1: *Descriptive Statistics of BMI and 600-Metre Run/Walk Performance (N = 224)*

Variable	N	Minimum	Maximum	Mean	SD
BMI (kg/m^2)	224	13.50	34.93	20.31	3.98
600-metre time (s)	224	49.33	449.68	207.81	70.40

The mean BMI of the 224 students was 20.31 kg/m² (SD = 3.98), while the mean 600-metre completion time was 207.81 seconds (SD = 70.40).

Association Between BMI and 600-Metre Run/Walk Performance

Table No. 2 : *Pearson Correlation Between BMI and 600-Metre Run/Walk Completion Time*

Variables	N	Pearson's r	p-value	Result
BMI and 600-metre time	224	0.175	0.009	Significant

A statistically significant positive association was found between BMI and 600-metre completion time, r(222) = 0.175, p = 0.009. Since a higher completion time indicates slower endurance performance, students with higher BMI tended to record slightly poorer endurance performance. However, the correlation was weak, indicating that BMI alone cannot explain the differences in endurance performance.

Hypothesis Testing

The research hypothesis was supported. The association between BMI and 600-metre run/walk completion time was statistically significant, r(222) = 0.175, p = 0.009. Therefore, the null hypothesis of no statistically significant association was rejected.

Discussion of Findings

The present study examined the association between BMI and cardiorespiratory endurance among 224 ICSE school students. A statistically significant positive relationship was found between BMI and 600-metre completion time. This indicates that students with higher BMI generally tended to require slightly more time to complete the endurance test.

The finding is generally consistent with previous research reporting an association between body composition and cardiorespiratory fitness among children and adolescents. Higher body mass can increase the physical demands of weight-bearing activities such as running, which may influence endurance performance. *(Ortega et al., 2008; Lang et al., 2018)*

However, the strength of the relationship in the present study was weak. This suggests that BMI alone does not determine cardiorespiratory endurance. Factors such as physical activity level, sports participation, training status, age, sex, nutrition, motivation, sleep, and other lifestyle characteristics may also influence endurance performance. (Raghuveer et al., 2020; Bull et al., 2020)

The findings also support the importance of school-based physical fitness assessment. Regular monitoring can help schools identify fitness needs and promote physical activity, healthy nutrition, and appropriate physical education programmes among adolescents.

Conclusion

It was concluded that a statistically significant but weak positive association existed between Body Mass Index and 600-metre run/walk completion time among the selected ICSE school students. Students with higher BMI generally tended to record higher completion times, indicating relatively poorer endurance performance. However, BMI alone cannot fully explain differences in cardiorespiratory endurance. Regular physical activity, endurance training, healthy nutrition, and continuous monitoring of health-related fitness remain important for the overall health and development of school students.

Recommendations

1. Schools should regularly assess students' BMI and health-related physical fitness.
2. Endurance-based activities such as running, jogging, brisk walking, and sports should be included in physical education programmes.
3. Students should be encouraged to participate regularly in physical activity.
4. Schools should promote awareness of healthy eating habits and active lifestyles.
5. Future studies should include larger samples and additional variables such as physical activity level, body fat percentage, muscular strength, flexibility, and lifestyle factors.
6. Future research may analyse boys and girls separately to examine possible differences in the relationship between BMI and endurance performance.

Limitations Of The Study

1. The study was conducted among students from a single ICSE school; therefore, the findings may not be generalised to all school students.
2. The cross-sectional design does not allow cause-and-effect relationships to be established.

3. BMI does not directly distinguish between fat mass and muscle mass.
4. Factors such as diet, physical activity level, sleep, motivation, and previous sports training were not examined.
5. Cardiorespiratory endurance was assessed using a field-based 600-metre run/walk test; laboratory-based measures such as VO_{2max} were not used.

References

American College of Sports Medicine. (2021). ACSM's guidelines for exercise testing and prescription (11th ed.). Wolters Kluwer.

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J.-P., Chastin, S., Chou, R., Dempsey, P. C., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C. M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P. T., … Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. British Journal of Sports Medicine, 54(24), 1451–1462. https://doi.org/10.1136/bjsports-2020-102955

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. Public Health Reports, 100(2), 126–131.

Lang, J. J., Belanger, K., Poitras, V., Janssen, I., Tomkinson, G. R., & Tremblay, M. S. (2018). Systematic review of the relationship between 20 m shuttle run performance and health indicators among children and youth. Journal of Science and Medicine in Sport, 21(4), 383–397. https://doi.org/10.1016/j.jsams.2017.08.002

Nuttall, F. Q. (2015). Body mass index: Obesity, BMI, and health: A critical review. Nutrition Today, 50(3), 117–128.

Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjöström, M. (2008). Physical fitness in childhood and adolescence: A powerful marker of health. International Journal of Obesity, 32(1), 1–11. https://doi.org/10.1038/sj.ijo.0803774

Raghuveer, G., Hartz, J., Lubans, D. R., Takken, T., Wiltz, J. L., Mietus-Snyder, M., Perak, A. M., Baker-Smith, C., Pietris, N., & Edwards, N. M. (2020). Cardiorespiratory fitness in youth: An important marker of health: A scientific statement from the American Heart Association. Circulation, 142(7), e101–e118. https://doi.org/10.1161/CIR.0000000000000866

Ruiz, J. R., Castro-Piñero, J., Artero, E. G., Ortega, F. B., Sjöström, M., Suni, J., & Castillo, M. J. (2009). Predictive validity of health-related fitness in youth: A systematic review. British Journal of Sports Medicine, 43(12), 909–923.

Tomkinson, G. R., Lang, J. J., Tremblay, M. S., Dale, M., LeBlanc, A. G., Belanger, K., Ortega, F. B., & Léger, L. (2018). International normative 20 m shuttle run values from 1,142,026 children and youth representing 50 countries. British Journal of Sports Medicine, 52(22), 1457–1464.

World Health Organization. (2006). BMI-for-age (5–19 years). World Health Organization.

World Health Organization. (2020). WHO guidelines on physical activity and sedentary behaviour. World Health Organization.